# PREFABRICATED STAIRWAY AND METHOD

This application is a continuation-in-part of Serial No. 09/711 854 filed November 13, 2000.

## FIELD OF THE INVENTION

The present invention relates to a prefabricated, plastic stairway for use between levels (e.g. floors and landings) of a building or other structure.

## BACKGROUND OF THE INVENTION

A common technique for fabricating a stairway between floors of a building, such as a residential home, involves fastening wooden stringers by nails and/or brackets to floor joists and nailing wooden treads and wooden risers between the stringers to form a plurality of steps. The stringers can be fastened to the floor joist first followed by fastening of the treads and risers to the stringers, or the stringers and treads/risers can be fastened together to form a heavy stairway unit that must then be moved into position and fastened to the floor joists.

An object of the present invention is to provide an improved prefabricated stairway for use between floors and landings of a building or other structure where the stairway is relatively lightweight, requiring no special equipment to facilitate transport and proper positioning at the building or structure site, and yet sturdy enough to withstand loads encountered in use, is resistant to wear and chemicals, and offers improved stairway aesthetics.

SUMMARY OF THE INVENTION

The present invention provides in one embodiment a prefabricated stairway comprising a pair of laterally spaced apart elongated stringers adapted to be disposed between levels (e.g. floors and landings) of the building and a plurality of integral riser and tread surfaces extending between the stringer sections so as to form steps. The stringers, riser surfaces and tread surfaces are formed integrally of a plastic material. A plurality of individual preformed tread members are fastened on the tread surfaces. The tread members can be made of plastic material, wood, metal and other materials. The stairway can include an optional landing surface and landing member fastened on the landing surface proximate the top and/or bottom of the stairway.

The prefabricated stairway preferably includes a joist attachment member disposed in a laterally extending channel formed integrally on the rear side of the topmost riser surface between the stringers. The joist attachment member is thereby incorporated into the stairway and adapted to receive fasteners, such as a lag bolts, by which the stairway is fastened to a joist of a building floor or landing.

The prefabricated stairway optionally can include receptacles formed integrally along the lengths of the stringers to receive ballaster posts and newel posts of a handrail.

The prefabricated stairway preferably comprises one or more outer filled resin layers and one or more inner fiber reinforced, filled resin layers applied on the outer filler resin layer(s).

In a preferred embodiment of the invention, the tread surfaces

are configured to include an integral reinforcement surface region, such as an integral reinforcement rib extending along a length of each tread surface. The reinforcement rib has a concave cross-sectional configuration residing below a plane defined by the respective tread surface and the landing surface. The preformed tread members preferably comprise of an outer ceramic filled gelcoat layer and one or more fiber reinforced, filled resin layers and are attached to the respective tread surfaces using fasteners. The fasteners preferably are captured in part in each tread member and optional landing member during molding so as to be integral therewith.

Another embodiment of the invention envisions fastening one or more tread members to one or more steps of an existing stairway made of wood, concrete, metal and other materials. One or more tread members can be fastened to refurbish one or more worn or damaged steps. One or more colored thread members can be fastened to one or more steps to enhance the visual appearance of the step(s).

The above and other objects and advantages of the invention will become apparent from the following detailed description taken with the following drawings.

DETAILED DESCRIPTION OF THE DRAWINGS

Figure 1 is an elevational view, partially in section, of a stairway pursuant to an embodiment of the invention.

Figure 2 is a sectional view of the stairway taken along lines 2-2 of Figure 1.

Figure 3 is a sectional view of the stairway taken along lines 3-3 of Figure 1.

Figure 4 is a partial plan view of the stairway.

Figure 5 is an elevational view, partially in section, of the stairway showing the tread members with integral fasteners.

Figure 6 is an enlarged exploded partial cross-sectional view of the tread surface and tread member.

Figure 7 is an enlarged partial cross-sectional view of the sprayed plastic wall of the stairway.

Figure 8 is a side elevation of the stairway after the tread members are fastened on the tread surfaces.

Figure 9 is a front elevation, partially in section, of the stairway installed in a stairwell showing wall studs and a handrail.

Figure 10 is an elevational view, partially in section, of a free-standing stairway pursuant to another embodiment of the invention.

Figure 11 is a plan view of the stairway of Figure 10.

Figure 12 is an elevational view, partially in section, of the free-standing stairway of Figure 12 showing ballaster posts and newel posts received in receptacles of the stairway.

Figure 13 is a sectional view of the stairway taken along lines 13-13 of Figure 10.

Figure 14 is a sectional view of a preformed tread member on a wooden step.

Figure 15 is a sectional view of a preformed tread member on a concrete step.

Figure 16 is a sectional view of a preformed tread member on a metal step.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figures 1-9, a prefabricated stairway 10 pursuant to one illustrative embodiment of the invention is shown to illustrate the invention but not limit the scope of the invention. The stairway 10 is illustrated as comprising a pair of laterally spaced apart elongated stringers 12 adapted to be disposed between levels of the building, such as for example between an upper floor and a lower floor or between a floor and a landing, and vice versa, as may be present in a split level home, and a plurality of integral riser surfaces 14 and integral tread surfaces 16 extending between the stringers 12 so as to form steps. Each stringer 12 includes an upstanding lower wall 12a, a laterally extending wall 12b and a second upstanding upper wall 12c. The stringer walls 12a, 12b are connected by integral reinforcing gusset 15 proximate the intersection of each riser surface 14 and tread surface 16. A plurality of individual preformed tread members 18 are fastened on the tread surfaces 16 as shown in Figures 5-6 and 8.

The prefabricated stairway is shown including a joist attachment member 20 disposed in a laterally extending channel 22 formed integrally on the rear side of the topmost riser surface 14, Figure 1. The topmost tread surface 16 above the channel 22 may be shortened in depth d compared to the other tread surfaces 16 so that the topmost tread surface is closely spaced to or abuts the floor 30. A correspondingly shortened tread member 18 is fastened on the topmost tread surface 16.

The joist attachment member 20 and channel 22 extend between the stringers 12. The channel 22 is formed integrally with the stringers 12 with the joist attachment member 20 incorporated in-situ in the channel 22 during the molding process described below. The joist attachment member 20 thusly is incorporated into the stairway 10 as an integral part thereof. The joist attachment member 20 can comprise conventional 2X4 lumber (2X4 stud) having a length to extend in channel 22 between the walls 12a of the stringers 12. The channel 22 includes top and bottom walls 22a, 22b, rear wall 22c, and a front wall that is formed by the rear side of the topmost riser surface 14.

The joist attachment member 20 is adapted to receive fasteners, such as lag bolts 25 (one shown), along its length by which the stairway 10 is fastened to a wooden floor or landing joist J as shown in Figure 1. The lag bolts 25 extend through the floor or landing joist J into the attachment member 20. The channel 22 can be drilled through its rear wall 22c to provide holes to receive the lag bolts. The invention is not limited to a joist attachment member 20 made of wood and can be practiced using an attachment member 20 made of plastic material, composite material and others. The attachment member 20 and channel 22 can be formed as a one molded solid integral member. The floor joist J shown can comprise conventional 2X8 or 2X12 lumber used in construction and support of the floor 30 of a building, such as a residential home. The floor 30 is shown comprising a sub-floor 30a and finished floor 30b pursuant to conventional floor construction practice. The joist J

is not limited to the lumber described since the floor or landing joist can comprise other types and sizes of lumber, engineered lumber, steel beams, and any other member used as a floor joist.

As shown in Figure 9, the upper region of the stringers 12 also can be fastened to wall studs WS by screws 34 extending through wall 12c of each stringer 12 into the wall studs. The wall studs typically are used to form a stairwell to receive the stairway 10.

As shown in Figure 1, the lower end of the stairway 10 rests on the lower floor 35, which may comprise a basement floor, a first floor when floor 30 is a second floor, a second floor when floor 30 is a third floor and so on, or a landing of a split level home. As shown in Figure 9, the lower end of the stairway 10 optionally can be fastened in position to wall studs WS by fasteners, such as screws 34, that extend through the wall portion 12c of each stringer 12. Holes can be drilled through the wall 12c, countersunk, and centered on the wall studs to receive the screws 34 to this end.

The tread surfaces 16 are generally flat and horizontal with the exception that they are configured to include an integral reinforcement surface region, such as an integral reinforcement rib 16a extending along a length dimension L of each tread surface 16, Figure 4. The reinforcement ribs 16a have a concave cross-sectional configuration residing below the plane defined by the tread surface 16. Each tread surface 16 is illustrated as having one reinforcement rib 16a generally centrally located on the tread surface. The number and location of integral reinforcement ribs 16a can be varied as desired in practice of the invention. The integral

reinforcement ribs 16a are formed during the resin spraying molding operation described above simply by providing the tread-forming surfaces of the master mold with rib-forming raised projections.

The tread surfaces 16 include a plurality of holes 16c that are adapted to receive fasteners 48 on the tread members. The holes 16c are formed in the tread surfaces 16 by first molding a dimple and then drilling once stairway 10 is removed from the mold. For purposes of illustration only, the holes 16c are formed in a pattern or array shown in Figure 4 to receive the fasteners 48 of the tread member 18 as shown in Figures 6 and 8.

The dimensions of the tread surfaces 16 can be selected as desired for a particular construction application. The tread surfaces 16 typically are of equal depth dimension DT from one tread surface to the next. The topmost tread 16 can be cut to have a shorter depth dimension d to fit an existing building configuration as illustrated in Figure 1. The topmost tread 16 if uncut would extend farther to the right to form a landing at the top of the stairway of Figure 1. The riser surface 14 and adjacent tread surface 16 define an included draft angle A, Figure 1, that can be 91 degrees for purposes of illustration but not limitation as other included angles A can be used.

The stairway 10 can include an optional landing surface (not shown) proximate the top and/or bottom of the stairway. For example, the topmost tread 16 can be extended in a direction to the right in Figure 1 to form a landing surface for the top of the stairway. A preformed landing member similar to a tread member 18

is fastened over the landing surface. Such a landing surface and landing member are described in copending U.S. application 09/711 854 filed November 13, 2000, the teachings of which are incorporated herein by reference.

The stairway can be made by spraying a suitable plastic material on a master mold. For purposes of illustration, the stairway 10 can be made by spraying in a first step, a first outer filled plastic resin layer 45 (Figure 7) using a filled resin system #1 as described in Table #1 through a commercially available two-chamber spray gun (e.g. PRO Series spray gun from manufacturer, Venus Gusmer Inc.) having a static mixer of sufficient length to thoroughly mix filled resin system #1 with a methyl ethyl ketone peroxide catalyst (e.g. High Point 90 by Witco Corporation) as it is sprayed on the surface of the mold. This mixture (i.e. resin system #1 and catalyst) is then allowed to polymerize or cure. The filled resin system #1 (step 1) is sprayed to form outer filled resin layer 45 to have a nominal thickness of about 0.030 inch. Although spraying is the preferred method of application, filled resin system #1 can be hand catalyzed, mixed, and then brushed on or poured on the surface of the mold and allowed to polymerized or cure.

After the aforementioned mixture forming outer filled resin layer 45 has cured, a step 2 involves spraying a second plastic layer 47A behind the first layer 45. The second layer 47A is formed by spraying the resin system #1 as described above on layer 45 immediately followed by spraying filled resin system #2 as

described in Table II and chopped fiberglass fibers through a two-chamber gun of the type described above having a static mixer of sufficient length to thoroughly mix filled resin system #2 with the above catalyst as it is sprayed. This spray gun is also be equipped with a conventional chopper head available from the above manufacturer to cut the fiberglass gun roving into 1" lengths. Both the chopped fibers and the filled resin system #2 are simultaneously sprayed behind the filled resin system #1 at a preferred ratio of 70% by weight of resin and 30% by weight of chopped fiberglass. The mixture is then rolled out and allowed to polymerize or cure to form fiber reinforced filled resin layer 47A. Step #2 described above is repeated twice more to form fiber reinforced filled resin layers 47B and 47C. Each fiber reinforced filled resin layer 47A, 47B, 47C has a nominal thickness of about 0.060 inch. The total thickness of the wall W of stairway 10 thus is about 0.21 inch, although other wall thicknesses can used in practice of the invention. A cross-section through the wall W of the one-piece base 20 is shown in Figure 7.

The joist attachment member 20 is incorporated in the stairway 10 by placing member 20 on the wall W after the layers 47A, 47B, 47C are cured. The member 20 is then sprayed as described above to form additional layers 47A, 47B, 47C on the fastening member 20 to form the channel walls 22a, 22b, 22c in-situ thereabout and thereby incorporate the fastening member 20 into the stairway as integral element thereof.

Table I

Resin System #1

Filled resin system #1 comprises a mixture consisting of 50% by weight of a synthetic plastic resin selected from the polyester or vinyl ester group, (although other thermosetting or other plastic resins may be found suitable), 46% by weight of a wollastonite based product as described in US Patent #4 568 604 and sold under the trademark "KZ6" by Ceramic Technologies Corporation of Rowley Iowa, 2% by weight of the mineral Talc, 1% by weight of a hollow microsphere sold under the trademark "Dualite" by Pierce and Stevens Corporation of Buffalo NY, and 1% by weight Titanium Dioxide. It will be understood by those skilled in the art that the above mixture has been found to be preferred but that deviation from the percents listed or the filler or other constituents used is within the scope of this invention.

Table II

Resin System #2

Resin system #2 comprises a mixture consisting of 75% by weight of a synthetic plastic resin selected from the polyester or vinyl ester group, (although other thermosetting plastic resins may be found suitable), 21 1/2% by weight of a wollastonite based product as described in US Patent #4 568 604 and sold under the trademark "KZ9" by Ceramic Technologies Corporation of Rowley Iowa, 2% by weight of the mineral Talc, 1/2% by weight of a hollow microsphere sold under the trademark "Dualite" by Pierce and Stevens

Corporation of Buffalo NY, and 1% by weight Titanium Dioxide. It will be understood by those skilled in the art that the above mixture has been found to be preferred but that deviation from the percents listed or the filler or other constituents used is within the scope of this invention.

It will be noted that the filled resin system #1 and filled resin system #2 each contain the catalyst described above so that the layers 45, 47A, 47B, 47C comprising the stairway wall W cure on the mold without the need for heating to this end.

The resin system #1 without chopped fibers and resin system #2 with chopped fiberglass fibers as described above are sprayed on a one piece, open-bottom master mold (not shown). The master mold is fabricated of the same material layers as described above sprayed on a master wooden pattern having a shape corresponding to that of the stairway 10. The fabricated master mold is provided with a draft angle of 9 degrees (or other suitable draft angle) that is imparted to the stairway 10 as a 9 degree top-to-bottom draft angle on each of the stringers 12 and risers 14. This draft angle allows the sprayed, cured stairway 10 to be removed vertically from the mold out of the open bottom of the mold, the stairway 10 being sprayed with the tread surfaces 16 oriented to face downwardly.

The preformed tread members 18 and the landing member (not shown), if used, typically are molded by applying (e.g. spraying, brushing and the like) a product sold under the trademark "KZ Ceramic Gelcoat", and taught in US Patent #5 688 851, herein called "KZ Gelcoat", mixed with the above catalyst to the surface of a

face-mold of a two-part mold and allowed to polymerize or cure to provide a layer nominal thickness of about 0.030 inch. Then, multiple layers (usually 2 to 4) of continuous fiberglass mat M, Figure 6, are placed in the face-mold behind the cured "KZ Gelcoat", the mold is then closed by clamping, bolting or otherwise connecting a rear-mold to the face-mold and filled with the above filled resin system #2 mixed with the above catalyst and allowed to polymerize or cure. The thickness of each tread member 18 and landing member, if used, is nominally about 0.20 inch.

The tread members 18 and landing member can be individually molded in a conventional two-part cavity mold comprising a face-mold and rear-mold mate-able to form a closed cavity, such as is used in RTM ( Resin Transfer Molding) or compression molding. Other molding techniques, which can be used, include but are not limited to injection molding, low pressure composite molding, and other conventional molding processes.

The tread members 18 and landing member, if used, are molded to capture integrally therein a plurality of threaded fasteners 48 each having enlarged fastener head 48a and a threaded shank 48b, Figure 6. The fasteners 48 are captured in each tread member by placing the head of the fastener between the aforementioned layers of the fiberglass mats M before molding. Capturing of the fasteners 48 in this manner is advantageous to hide the fasteners from view when the stairway 10 is assembled.

The tread members 18 and the landing member, if used, are molded to include integral pilot protrusions 18p on the underside thereof and adapted to be received in a respective hole 16c in the underlying tread surface 16 and landing surface.

The tread members 18 are also molded to include an integral bull nose 18n that depends or extends downwardly about the front periphery of the tread member to overlap and hide the adjacent riser surface 14 located therebelow as will be appreciated from Figure 8. The rear periphery of each tread member 18 comprises a straight edge 18e. The bull nose 18n includes a straight lip region 18nl and a radius region 18nr.

The landing member, if used, is also molded to include an integral bull nose that depends or extends downwardly about the front periphery of the landing member to overlap and hide the adjacent riser surface 14 located therebelow.

The bull noses 18n on the tread members 18 and landing member, if used, provide an aesthetically pleasing appearance to the stairway when assembled.

The tread members 18 and landing member can be made of materials other than plastic material described above. For example, the invention envisions making the tread members 18 and landing member, if used, out of wood, metal, and other suitable materials using conventional wood working, metal working and other techniques.

The tread members 18 are fastened to the respective tread surfaces 16 by inserting the threaded shank 48b of the fasteners 48 through the holes 16c and assembling and tightening a nut 52 on the shank 48b with a washer 53 positioned between the nut 52 and the underside of the tread member, Figure 6. The landing member, if used, can be fastened in like manner to a landing surface provided on the stairway 10.

The tread members 18 and the landing member, if used, can be molded to provide an anti-slip surface on the upper surface thereof. A diamond anti-slip surface pattern for purposes of illustration only can be molded into the entire upper surface of the tread members 18 and landing member, if used, if desired as described in U.S. Serial No. 09/711 854 filed November 13, 2000, incorporated herein by reference. Other anti-slip surfaces can be molded into the upper surfaces of the tread members and/or the landing member to suit a particular construction application. Moreover, the tread members 18 and landing member, if used, can be molded to impart any desired decorative appearance thereto. For example, they can be molded to have a stone, brick or other desired surface appearance. Still further, the color of the tread members and the landing member can be selected to provide any desired aesthetic appearance. For example, the color of the tread members 18 and landing member can be different from that of the stairway 10 and matched to the color of the building or structure.

In use, should a tread member 18 or a landing member, if used, become damaged for some reason, it can be removed from the stairway 10 by removing the nuts 52 and washer 53 and then fastening a replacement tread member or landing member in its place.

The stairway 10 can be installed in a stairwell formed by wall studs WS in conventional manner as shown in Figure 9. The upper end of the stairway 10 can be fastened to the floor joist J as shown in Figure 1 and described above. The upper region of the stringers 12 also can be fastened to the wall studs WS by screws 34 extending

through wall 12c of each stringer 12 into the wall studs. The lower end of the stairway 10 can be fastened to wall studs WS located proximate stringers 12 using like screws 34 extending through walls 12c of each stringer 12. A filler strip or shim lathe 60 is nailed on the wall studs WS to be flush with the wall 12c of each stringer 12 as shown. Sheet rock (also known as dry wall sheet) 62 is then nailed on the filler strip or shim lathe 60 to overlap the stringer wall 12c as shown in Figure 9. A bead of caulk 64 then can be applied to complete the joint between the stairway 10 and the sheet rock 62. A handrail 70 mounted on bracket 72 is fastened to the wall studs WS using screws 72 extending through the bracket 72 into the wall studs as shown. The handrail can extend the length of the stringers 12.

Referring to Figures 10-13, a free-standing stairway 10' pursuant to another embodiment of the invention is illustrated. In Figures 10-13, like features of Figures 1-9 are represented by like reference numerals primed.

The stairway 10' includes stringers 12' that each include upstanding inner wall 12a', a lateral wall 12b', and a downwardly extending outermost wall 12d', with the walls 12b' being molded to include receptacles 13a' and 13b' for receiving the lower ends of ballaster posts 80' and newel posts 82', respectively, that support a handrail 84'. The outermost wall 12d' extends downwardly to provide the outer visible wall of the stairway. Although not shown in Figures 10-13, reinforcing gussets similar to gussets 15 of Figures 1-9 are provided on stairway 10'. The receptacles 13a' are

sized and shaped to receive the lower ends of the ballaster posts 80', while the receptacles 13b' are sized and shaped to receive the lower ends of the newel posts 82' as shown in Figure 12. The lower ends of the posts 80' and 82' are fastened in the receptacle 13a', 13b' by suitable adhesive and/or by a screw (not shown) extending upwardly through a hole 17' drilled in the bottom of each receptacle 13a', 13b' (only some of the holes 17' being shown for the receptacles 13b'). The ballaster posts, newel posts and handrail can be made of wood, metal (e.g. wrought iron), plastic material and other materials.

The upper region of the stairway 10' can be fastened to the upper floor 30' via its floor or landing joist J'. The lower region of the stairway 10' can rest on the lower floor 35' and be fastened to the floor by a screw (not shown) extending through the bottom of each ballaster receptacle 13a' for fastening to the floor or landing 35', which can be wood, concrete or other floor conventional floor material. The type of screw used to fasten the stairway on the floor or landing 35' would be selected in dependence on the floor or landing material present. If the ballaster posts are glued in the receptacles 13a', the floor screw can extend through hole 17'. An additional screw hole (not shown) can be provided otherwise in the bottom of receptacle 13a'.

A decorative cover panel 100' can be attached by screws 102' to lowermost (bottom) edges of stringer outer walls 12d' to hide the bottom of the stairway from view, Figures 10 and 13. The channel 22' may include chamfered corner 22e' to accommodate the cover

panel 100' as illustrated in Figure 10. The cover panel 100' can be made of sheet rock (drywall), wood or composite wood paneling, plastic paneling material or any other panel material.

Although not shown in Figures 10-13, it is understood that the tread surfaces 16' of stairway 10' will have fastened thereon as described above a respective tread member like tread member 18 of Figure 8 to complete the stairway 10'.

Referring to Figures 14-16 where like features of previous figures are represented by like reference numerals double primed, an embodiment of the invention envisions fastening one or more of the tread members 18'' on a tread T'' of one or more steps S'' of an existing stairway SW'' made of wood (Figure 14), concrete (Figure 15), metal (e.g. steel, Figure 16) and other materials. One or more tread members 18'' can be fastened to refurbish one or more worn or damaged treads of the stairway between the stringers ST''. Alternately, one or more safety-colored (e.g. yellow, orange, red, etc,) thread members 18'' having a color different from the color of the steps S'' can be fastened to one or more steps S'' to enhance the visual appearance of the step(s) for aesthetic and/or safety purposes. The tread members 18'' can be fastened to the treads T'' by any appropriate means such as threaded fasteners 48'', nuts 52'', and washers 53'' as illustrated in Figures 14-16, adhesive, and/or other suitable fastening technique. The tread members 18'' can be molded or post-mold drilled as described above to include holes 18c'' to receive the fasteners 48', rather than having the fasteners captured integrally in the tread member 18''. The treads T'' can be conventionally drilled to provide holes H''

to receive the fasteners 48''. Alternately, if the thread members 18'' will be adhesively attached to the steps S'', the holes 18c'' may be omitted. Each tread member 18'' can include the bull nose 18n'' that overlaps the adjacent riser surface of the step S'' and a straight edge 18e'' at the rear of the tread member 18''. The tread members 18'' can be molded without or with the pilot protrusions 18p, Figure 6, described above. Otherwise, the tread members 18'' have a cross-section similar to that of Figure 6. In Figures 14-16, the pilot protrusions are omitted from the tread members 18''.

Figure 15 illustrates a landing member 19'' to be fastened on the top landing surface L'' of the concrete stairway SW''. The landing member 19'' is molded or drilled to include holes 19c'' in the same manner described above for the tread members 18 and can be fastened on the stairway landing surface L' using fasteners 48'' through holes 19c'', nuts 52'' and washer 53'' as described for the tread members 18'', adhesive or any other suitable fastening technique as described for the tread members 18''. The landing member 19'' includes a bull nose 19n'' around its entire periphery.

The present invention is advantageous to provide an improved prefabricated stairway for use between floors of a building or other structure where the stairway is relatively lightweight to facilitate transport to and proper positioning at the building or structure site and yet sturdy enough to withstand loads encountered in use, is resistant to wear and chemicals, and offers improved

stairway aesthetics. Also, the invention envisions fastening one or more tread members on worn steps to refurbish the steps and/or to enhance the visual appearance of the step(s) for aesthetic or safety purposes.

Although the invention has been described with respect to certain specific embodiments, it is not limited thereto and can be modified and changed within the scope of the appended claims.